

# Mathematics, numeracy and e-learning

The integration of information and communication technology (ICT) into school educational practice is seen as being crucial to prepare “young people to participate in and contribute to an information society that requires high levels of literacy, numeracy, technological competence and a spirit of creativity and enterprise” (DETYA, 2000, p.17).

In National Literacy and Numeracy Week 2002, the Commonwealth Bank e-Learning Grants program was launched, and has continued annually since then, providing a total of \$350 000 funding each year for literacy and numeracy e-learning projects in Australian primary schools. In the first year, applications were submitted by 1300 Government, Catholic and Independent schools, which represented almost 20% (19.4%) of all primary schools in Australia. Four hundred and sixty-four schools provided consent for the information contained in their applications to be analysed with the purpose of determining the characteristics of e-learning in this context.

This article presents a description of the nature of the projects that focused on using ICT to support the teaching and learning of mathematics and numeracy (e-learning). The innovative ideas these schools proposed might encourage or inspire other teachers to attempt similar uses of ICT in their mathematics programs.



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report on the  
range of  
innovative uses  
of ICT in schools.

## Project focus

The e-Learning Grants application form asked teachers to describe how the grant would be innovatively used to enhance English/literacy and/or mathematics/numeracy learning outcomes. Numeracy was the focus for only 7% of the schools. Projects that involved both literacy and numeracy accounted for one-third of the projects (33%). So, 40% of the schools proposed projects that focused on either numeracy or integrated both literacy and numeracy.

## Numeracy projects

The mathematics/numeracy projects varied in nature, including aims such as improving basic mathematical skills, developing thinking, problem solving and working mathematically skills, and providing opportunities for integration and application of mathematical skills in broader projects. Project descriptions also often referred to using ICT as a motivational device to combat negative attitudes towards mathematics. The following quotes from school project descriptions indicate the diversity and scope of numeracy proposals.

...the possibility of designing an online computation module to be used in our computer lab to run in conjunction with and be supportive of the work being done in the classroom... The ultimate goal is that students have instant recall of basic facts (single digit addition

and multiplication), have developed flexible strategies for a wider range of mental calculations, and turn to paper and pencil or calculator for more complex computations. (Tasmanian Catholic school)

As a distance education school it is very difficult to provide sufficient numeracy and open-ended challenge material for all our children... Access to the Internet and e-learning has to be one of the best possible ways we can achieve this. (Northern Territory Government school)

We propose to develop a variety of learning experiences based around the measurement, number, data and space strands... to undertake investigations in the community and within the school grounds... Using technology will be an integral element in the investigation, calculation and presentation stages of each activity. (Queensland Government school)

...become numerate by connecting new information and concepts to what they already know. It involves an inquiry approach to learning... the e-Learning Grant would assist in maintaining and developing our existing programs, particularly with a view to extending and developing our range of software." (NSW Catholic school)

## Combined literacy and numeracy projects

The 33% of school projects that contained a combination of literacy and numeracy aims, covered a variety of project types, including those that integrated several curriculum areas. In many projects, a tendency for the literacy aspects to dominate the numeracy aspects was apparent. The following selection of quotes indicates the variation in approaches from a skills development focus to viewing literacy and numeracy as aspects naturally occurring within broader learning experiences.

Our school-wide initiative involves purchasing software to further develop and extend students in both literacy and numeracy. (Queensland Government school)

...approach to learning ensures that both literacy and numeracy are embedded within each of our students' Learning Journeys [extended, in-depth research projects]... Without realising it, these students had covered all the Literacy Outcomes of Speaking, Listening, Reading, Viewing & Writing; and were Thinking and Working Mathematically as well as exploring Space, Number, Chance & Data. (ACT Independent School)

Our initiative will draw on our local natural environment to stimulate and enrich learning... Monitoring and recording selected animal movements and plant status will reinforce formal numeracy lessons. Sharing these discoveries with others in the school by means of an e-book, i.e., a visual record of these discoveries, so that each child in the school will have access to the program and with others in a network will foster improved literacy and reinforce literacy concepts already learned. (NSW Government school)

Many schools described their projects in sufficient detail to communicate their understanding of the nature of literacy and numeracy, as well as how “new literacies” associated with the use of ICT create new teaching and learning expectations.

**Literacy:** Focus on producing multimodal communication in different media and contexts, e.g., move from monomodal texts such as a spoken radio ads, to multimodal and interactive digital texts such as online advertisements, which combine moving, visual images, music, voice and sound effects

- Critically analyse the intended use of and availability of digital and electronic technologies as a means of communication, information analysis and storage.

**Numeracy:** Sensible use of technology in concept development, as well as in technology-assisted approaches to problem-solving, modelling and investigative activities.

- Use information and communication technologies to obtain diagrams, graphs, tables and other data to be used in subsequent mathematical activity.
- Use the statistical functions of a spreadsheet, or even a special purpose statistical software package.

- Work on tables, graphs and equations using calculators or computer software with capabilities, such as a spreadsheet, graphing software.
- Use a drawing package that enables the user to construct simple diagrams involving two- and three-dimensional geometric shapes in space.
- The effective and appropriate use of information and communication technologies in the learning and application of mathematics, in particular where systematic analysis of results is required.

(Queensland Government school)

## Types of pedagogy and innovation

A growing body of research (for example; Goodyer, 1999; Hannifin, 1999; Hayes, Schuck, Segal, Dwyer & McEwen, 2001) identifies the potential of computer-based technologies to transform pedagogy in the following ways:

- a shift from “instructivist” to constructivist education philosophies;
- a move from teacher-centred to student-centred learning activities;
- a shift from a focus on local resources to global resources; and
- an increased complexity of tasks and use of multi-modal information.

The teacher's own pedagogical beliefs and values play an important part in shaping technology-mediated learning opportunities. The teachers' descriptions of the ways in which they envisaged ICT contributing to student learning, particularly in mathematics/numeracy revealed their current beliefs about pedagogy and their perceptions of innovative use of ICT in their particular school context. These descriptions could be categorised into three types, which are outlined below.

### **Type 1: ICT as innovative objects**

Type 1 teachers focus on the newness of the technologies, what the technologies can do and how they can be used in classrooms. To some extent, Type 1 teachers are innovative because they are making use of ICT that have never been used in the classroom before. Only 13% of all projects were classified as Type 1.

The project descriptions include references to factors such as:

- computer labs;
- basic skills in literacy and numeracy;
- core IT skills (word processing);
- increased confidence and ICT experience;
- raising expectations;
- efficiency of organisation, time, access to information, planning; and
- motivation of reluctant learners.

For example:

As a direct result of the e-learning grant, literacy and numeracy programs would be supported with enhanced use of technology... This initiative is innovative for our school, as we have never used technology as a tool to improve specific learning outcomes. (New South Wales Government school)

Some schools of this type regarded themselves as disadvantaged and the newness of the technologies reflected this disadvantage.

A recent survey revealed that less than 50% of students have access to a computer at home and even amongst those who have computers at home, only a few have Internet access. Students are therefore significantly disadvantaged in developing e-learning skills. (Queensland Government school)

### **Type 2: ICT as a curriculum tool**

Teachers in Type 2 have some experience with ICT, are aware of some of the things ICT can do and evaluate their utility in the context of improving student outcomes. ICT is used because it can make teaching and learning more efficient. The majority of the school projects (73%) in the study were classified as Type 2.

The project descriptions in this category emphasise factors such as:

- learning opportunities provided through the use of ICT;
- curriculum delivery enhancement;
- ICT as an educational tool, powerful tool, information tool, productivity tool, support tool, tool to enhance learning;
- integrating ICT across learning areas;
- online units of study;
- designing rich learning resources;
- a tool for assessment; and
- the development of descriptors for competencies, achievement and curriculum outcomes.

The following quotes are typical of the way teachers are describing ICT as a “curriculum tool”.

Using information and communication technologies as a tool, the teachers are able to assist children having difficulty to meet particular mathematical outcomes as well as giving all students an opportunity to gain more practice and assistance from computer programs. (Victorian Catholic school)

...access to computer based technology as a tool for learning and revision in areas of need. (NSW Government school)

Use e-learning as a tool in assessment... (NSW Catholic school)

One of our high priority goals of our school Strategic Plan (2002–2004) is to incorporate e-learning as a major tool within the classroom. It is our aim to provide the students with the necessary skills, facilities and opportunities to construct meaning and to engage interactively with e-learning. (NSW Catholic school)

### Type 3: New learning environment

In Type 3 classrooms there has been some history of the use of ICT. Approaches to using the ICT are challenged, not by the technologies, because the teachers are aware of their potential, but by the impact they have had on how teachers perceive their own role, how classrooms can be organised and the relationships that develop within them, and how new learning tasks/experiences can be structured. Out of all the schools, 14% expressed the idea that ICT enables new or creative learning environments and, thus new ways of teaching and learning.

The project descriptions feature factors such as:

- meaningful and relevant learning strategies;
- learning styles or multiple intelligences,
- inquiry oriented online tools;
- collaboration and co-operation; and
- new ways of learning, personalised, realistic, self-paced, self-directed, non-linear, self-assessed.

Learning environments are described as:

- virtual;
- real-time synchronous;
- geographically remote,
- collaborative,
- networked;
- global;
- communities; and
- e-learning spaces.

For example:

Our e-learning initiative compliments constructivist learning theories describes in the SACSA Framework. Especially as a part of student initiated curriculum our students are supported to choose key ideas from SACSA to plan learning challenges. (South Australian Government school)

The introduction of the intranet is assisting the school to change the perception and use of ICT. Our planning is to make multiliteracies and global communities priorities in our 2003–2005 charter. This is evidence of a commitment to the development of e-learning. (Victorian Government school)

## Numeracy projects and pedagogy & innovation type

Interestingly, when the numeracy focus projects are examined separately from the other projects, a much higher proportion (43%) of them fall into the third type (new

learning environment) than is the general trend (14%). In contrast, the combined literacy and numeracy projects only register a very small proportion (4%) of Type 3 pedagogy and innovation (see Figure 1). The reasons for these differences are not obvious.

## Conclusion

When new technologies are introduced in schools, whether they are a computer in a classroom, a computer connected to the Internet, the creation of an intranet, digital cameras, data projectors or multimedia and digital video, teachers need significant time to develop their skills and confidence in using the technology and then time to experiment with using the technologies in their current classroom practice. Whatever the technology, the evidence contained in the teacher descriptions suggests that they will initially focus on the technological object, and the skills necessary to use the object. This then becomes the foundation on which they develop pedagogical skills to use the technological object within current practice and curriculum frameworks, and, given the time and opportunity, to reflect and consider new uses for the technologies and new teaching approaches that may result in significant changes in the learning environment. In the case of numeracy projects, it was heartening to see that the majority of schools in the sample had moved beyond thinking of computer technology as a resource for just low-level mathematical skill development and were exploring technology as a medium for higher-level mathematical thinking and numeracy. Effective teaching and learning has its basis in sound pedagogical frameworks and the successful integration of ICT in classrooms relies on sound pedagogy.

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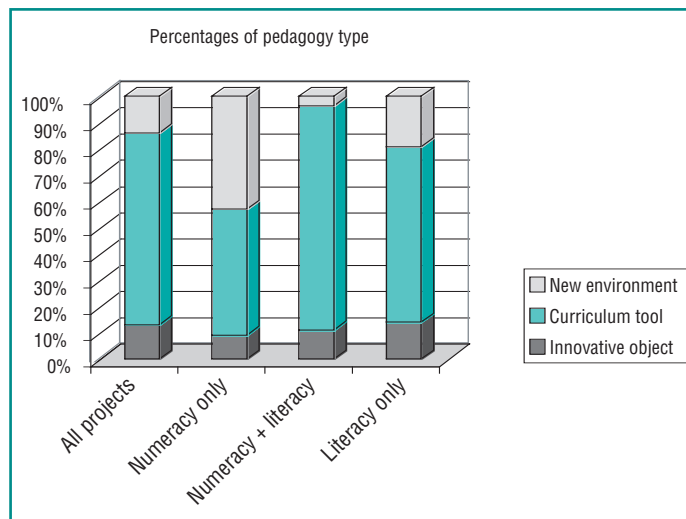


Figure 1. Graph of percentages of pedagogy type.

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